The Impact of Information Provision on Revealed-Preference Support for Climate Policies*

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August 22, 2024

Abstract

Motivated reasoning may exacerbate the divergence of opinions over global challenges, such as climate change. As a result, politicians may adopt less effective measures to combat these challenges either because they themselves have motivated beliefs or because they cater to constituencies with motivated beliefs. In an online experiment where a broad sample of the German population makes consequential decisions about abatement options, we analyze whether motivated reasoning among supporters of climate action favors less effective measures. We find that individuals prefer a concrete over an abstract abatement measure, but are responsive to information that the abstract measure is more effective. There is no evidence for motivated reasoning. The results imply that support for effective climate policies can be increased through information provision.

*This paper draws on funding by the Deutsche Forschungsgemeinschaft (DFG) via Excellence Cluster CLICCS (EXC 2037, 390683824), the Bundesministerium für Bildung und Forschung (BMBF) via project ARIADNE (03SFK5S0) and ARIADNE 2 (03SFK5C0-2), and the Helmholtz Gemeinschaft (HGF) via Helmholtz ESD project RESUR. Data were collected in collaboration with the survey institute *forsa* under commercial contract. The study was pre-registered in the Randomized Controlled Trial Registry of the American Economic Association under code AEARCTR-0009305. Research Ethics Board approval has been granted by the Vice-Dean for Research of the Faculty of Economics and Social Sciences of the Universität Hamburg, Prof. Alexander Szimayer, on June 9th, 2022. We are highly grateful for valuable comments by Peter Andre, Beat Hintermann, and participants of the RWI Brown Bag Seminar.

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Keywords: climate policy; cap-and-trade; coal phase-out; information provision; motivated reasoning; field experiment

JEL classification: C93, D02, D83, D91, Q54, Q58

1 Introduction

A growing strand of the literature in economics, political science, social psychology, and neuroscience provides empirical evidence that people tend towards directional motivated reasoning, that is, their information processing is systematically biased towards the goal of arriving at a particular conclusion (Druckman and McGrath, 2019; Kunda, 1990). In other words, individuals are more likely to consider information credible if it is consistent with their prior beliefs (Kunda, 1990). Motivated reasoning may reinforce the divergence of opinions over the severity of global challenges, such as climate change, and appropriate measures for mitigation. As a consequence, individuals and politicians might choose ineffective measures widening the implementation gap in climate policy (Fransen et al., 2023; Lecocq et al., 2022; Liu and Raftery, 2021; Perino et al., 2022a; Rogelj et al., 2023; UNEP, 2023). For instance, fearing strong protests, policymakers may set carbon prices that are too low (Carattini et al., 2019; Douenne and Fabre, 2022; Le Yaouanq, 2023).

Motivated beliefs are difficult to update, as they tend to be more inert to conflicting information than "rational" beliefs (Bénabou and Tirole, 2002; Kuzmanovic et al., 2018; Luo and Zhao, 2019; Möbius et al., 2022; Yao et al., 2021). They have been documented for a wide range of topics, such as individual abilities and character (Bolte and Fan, 2024; Castagnetti and Schmacker, 2022; Chew et al., 2020; Kahan, 2013; Möbius et al., 2022; Munro and Stansbury, 2009; Thaler, 2021; Zimmermann, 2020), future life events (Ganguly and Tasoff, 2017; Kuzmanovic et al., 2018; Oster et al., 2013; Yao et al., 2021), the COVID-19 pandemic (Hutmacher et al., 2022), and climate change (Kahan, 2013; Zappalà, 2023; Zhou, 2016). Yet, some studies fail to find evidence for motivated reasoning (see Bago et al. (2023) and Ripberger et al. (2017) on climate change, Barron (2021) on

financial outcomes, and Coutts (2019) on ego-relevant and financially relevant outcomes) or even find contradictory evidence (see Ertac (2011) on ego-relevant outcomes).

The empirical evidence on motivated reasoning about climate policy remains inconclusive as well. Douenne and Fabre (2022) conducted a stated-preference experiment in France on the acceptance of a carbon tax. They find that, compared to respondents who endorsed the policy, supporters of the yellow vest movement are less likely to update their beliefs about the tax after being informed that they would benefit from it. However, a replication by Rivers et al. (2023) shows that these results are potentially biased. Further, Jarke-Neuert et al. (2023) document behavior that is inconsistent with motivated reasoning on climate policy in a consequential online experiment. However, they do so in a context that is relatively alien to individuals and hence strongly motivated beliefs might have been less likely to form.

Adding to this line of inquiry, the present paper provides novel evidence on motivated reasoning in the context of support for existing climate policy instruments, one of which has been the focus of several campaigns and protest movements (Ende Gelände, 2023; Fridays for Future, 2023). It is hence likely that motivated beliefs have been formed related to this specific policy. The evidence originates from a survey-based, consequential online experiment with a large sample of members of the German Socio-Ecological Panel (Frondel et al., 2023; Klick et al., 2021). At the heart of the experiment lies the choice between an abstract, less well-known but highly effective mitigation option and a concrete, intuitive and popular, but less effective abatement option.

The abstract abatement option, which we label *ETS*, reduces emissions through the cancellation of emission allowances of the European Union's Emission Trading System (EU ETS). The EU ETS imposes a binding cap on the total emissions of the EU's industry

and power sectors.[1] The option is equivalent to a marginal tightening of the aggregate cap on emissions by the regulator, e.g. as those that have been discussed at the point in time the experiment was conducted (in summer 2022) in the context of the EU's 'fit-for-55' package. The concrete abatement option, *COAL*, marginally brings forward the mandatory coal phase-out (currently set to be completed by 2038 according to the German Coal Phase-Out Law (Kohleausstiegsgesetz, 2020)) as it is demanded by climate activists, such as the Fridays for Future movement (Ende Gelände, 2023; Fridays for Future, 2023).[2] At the time of the experiment, the federal government of Germany and the state government of North Rhine-Westphalia negotiated a deal on moving forward the end of lignite extraction and lignite-based power generation in the region by several years to 2030 (Reuters, 2022). The third option, *MIX*, is a (linear) combination of abatement options *ETS* and *COAL*, thereby reflecting the actual implementation of the national coal phase-out in Germany. The coal phase-out reduces the carbon emissions of the German power sector, but, due to the coexistence of the ETS, only leads to equivalent emission reductions at the EU level when all the allowances that are superfluous due to the coal phase-out are cancelled (Kohleausstiegsgesetz, 2020; Treibhausgasemissionsgesetz, 2011). Note that for the regional lignite phase-out in North Rhine-Westphalia, no agreement on cancellation of emission allowances has been negotiated. Hence, all three abatement options *ETS*, *COAL*, and *MIX* match real-world climate policies of Germany and the European Union. In each of four experimental conditions, subjects were asked to choose twice between one of the three mitigation options *ETS*, *COAL*, and *MIX*, or the outside option of no mitigation (option *NONE*), with a "Don't know / No answer" response being also available.

[1] Cancellations were conducted by ForTomorrow gGmbh according to the 'buy, bank, burn' procedure derived by Gerlagh and Heijmans (2019).

[2] This option was implemented by STEAG GmbH, Essen, through a reduction of output of a coal-fired power plant to avoid CO_2 at their Herne IV plant on 2nd September 2022.

The conjecture underlying our research is that motivated reasoning is more likely for those abatement options to which people are emotionally attached to (Akerlof and Kranton, 2000). It can be expected that, among the general population, such emotional links are more likely to exist for the coal phase-out than for the ETS. Indeed, there has been substantially more public debate and protests around phasing-out coal power plants and coal extraction in Germany than about the ETS (Liersch and Stegmaier, 2022; Machin, 2019; Markard et al., 2021), albeit both policies aim at coal-fired power plants in Germany. We hypothesize that individuals who had participated in protests demanding a (faster) coal phase-out in the past, which is a strong indicator of identification as an anti-coal activist, and individuals who received an information treatment that emphasized the importance of coal combustion for CO_2 emissions and stated how emissions from coal-fired power plants had increased in the recent past (condition *SHAME*) would react less to information that the retirement of ETS emission allowances is the more effective climate policy. This would mean that precisely those individuals who claim to be most concerned about climate change opt for less effective mitigation options because of their emotional involvement. Contrary to what was hypothesized, we find no evidence for motivated reasoning.

The remainder of the paper is structured as follows. Section 2 describes the experimental design. Section 3 analyzes how subjects generally choose between the three mitigation options. Our key results on motivated reasoning are presented in Section 4. Section 5 summarizes and concludes.

2 Experimental Design

The data for our experiment is drawn from the German Socio-Ecological Panel (Frondel et al., 2023; Klick et al., 2021) and was collected in summer 2022. Data collection was car-

ried out in collaboration with forsa (`www.forsa.com`), a survey institute that maintains a panel of more than 100,000 individuals who are representative of the German-speaking internet users aged 14 and older in Germany. Panel members are recruited offline, with each individual of the population having the same probability to become a panel member. In total, 6,583 adults participated in the survey, of which a random sub-sample of 2,001 individuals was drawn to participate in our experiment and were randomly assigned to four experimental groups: *BASE*, *MARKET*, *SHAME*, and *REFORM*.

The experimental design is illustrated in Figure 1. The experiment started with a detailed explanation of the choice task and the choice options. The choice set was:

- Retiring 10 ETS allowances, equivalent to 10 tons of CO_2 (Option *ETS*)
- Reducing the emissions from a coal-fired power plant in Germany by 10 tons (Option *COAL*)
- Retiring 5 ETS allowances, equivalent to 5 tons of CO_2, and reducing the emissions from a coal-fired power plant in Germany by 5 tons (Option *MIX*)
- No climate action (Option *NONE*)

The response option "Don't know / No answer" was also available.[3] To obtain incentive-compatible responses, one out of sixty decisions was implemented with the help of the operator of a coal-fired power plant and an NGO that retires ETS allowances.[4]

Each subject made two choices in sequence, $d = 1$ and $d = 2$. In the baseline condition *BASE*, subjects were first requested to choose without any further information on the effectiveness of each option on total CO_2 emissions ($d = 1$), whereas information on the

[3]Ten tons of CO_2 are roughly equivalent to the yearly carbon footprint of an average German citizen (Our World in Data, 2023).

[4]The retirement of 170 EU ETS allowances was implemented by the non-profit NGO ForTomorrow gGmbH, Berlin and output of a coal-fired power plant was reduced to avoid 100 tons of CO_2 by STEAG GmbH, Essen at their Herne IV plant on 2^{nd} September 2022. In a cognitive pretest there was no indication that participants did not believe in the measures to be implemented.

<table>
<tr><th>BASE</th><th>MARKET</th><th>SHAME</th><th>REFORM</th></tr>
<tr><td colspan="4">Questions on attitude towards large firms and market economy, participation in protests for climate protection and coal phase-out</td></tr>
<tr><td></td><td></td><td></td><td>Info on impact of options on total CO2 emissions in EU under current rules</td></tr>
<tr><td></td><td>Framing:
ETS as an instrument restricting markets</td><td>Framing:
Highlighting contribution of coal-fired power plants to CO2 emissions</td><td></td></tr>
<tr><td colspan="4">First choice (d=1)</td></tr>
<tr><td colspan="4">Elicitation of belief about effectiveness of options in reducing CO2 emissions</td></tr>
<tr><td colspan="3">Info on impact of options on total CO2 emissions in EU under current rules</td><td>Info on impact of options on total CO2 emissions in EU under proposed reform</td></tr>
<tr><td colspan="4">Second choice (d=2)</td></tr>
<tr><td colspan="4">Elicitation of beliefs over financial impact of options</td></tr>
</table>

Figure 1: Experimental design

true effect under the then current rules of the EU ETS was given prior to the second decision $d = 2$ (see the full choice setting in Appendix D). In fact, under the rules at the time of conducting the experiment, the reduction of emissions from a coal-fired power plant (option *COAL*) is least effective and reduces total emissions by only 4.2 tons of CO_2. The retirement of ETS allowances (option *ETS*) is most effective with a reduction of overall emissions of 10 tons of CO_2. Option *MIX* reduces total emissions by 7.1 tons of CO_2. Table 1 summarizes the impact of all options on total emissions in the EU. The difference is due to interactions between the emissions of a coal-fired power plant, the power market, and the ETS (Perino, 2018).

Treatment conditions *MARKET* and *SHAME* were identical to the baseline condition, except for a different framing of the decisions that was implemented by an additional sentence in the instructions. In the *MARKET* condition, it was stressed that the ETS (as opposed to calling it a "market-based" instrument) is an instrument that *restricts* markets, providing the government a direct control over total emissions (see Appendix D.5). In the *SHAME* condition, the importance of coal combustion for CO_2 emissions was em-

Table 1: Impact on total CO_2 emissions in the EU (in tons of CO_2) at time of experiment (2022).

	Reduction of emissions (in tons of CO_2)			
	Under current rules		Under proposed reform	
Option	Nominal	Real	Nominal	Real
ETS	10	10.0	10	10
COAL	10	4.2	10	10
MIX	10	7.1	10	10

See Appendix B for a detailed explanation of the effectiveness of the different options.

phasized and it was stated how emissions from coal-fired power plants have increased in the year prior to the survey (see Appendix D.3).

In the *REFORM* condition, by contrast, information on the effect of each option on total CO_2 emissions under the then current rules of the ETS was given before $d = 1$, and information on the effect of each option on total CO_2 emissions under a then proposed reform of the ETS was given in $d = 2$ (see Appendix D.12 and D.13).[5] Under the proposed reform, all options would be equally effective and reduce total emissions by 10 tons of CO_2 (see Table 1 and Appendix B). In sum, there was an informational manipulation between the first decision ($d = 1$) and the second decision ($d = 2$), but the details of this information manipulation varied across the between-subjects conditions *BASE*, *MARKET*, *SHAME*, and *REFORM*.

Across all experimental conditions, after the first discrete choice task ($d = 1$), we elicited the respondents' beliefs about the effectiveness of all options for the reduction of total greenhouse gas (GHG) emissions in the EU. After the second discrete choice task ($d = 2$), we elicited their preferences over the financial impact of all options (see Appendix A).

Participation in the survey was voluntary and subjects could choose to drop out at

[5]Note that the proposed reform of the EU ETS and in particular its Market Stability Reserve has been implemented in the meantime (Borghesi et al., 2023).

any point. Table 2 summarizes the sampling and assignment process, specifying the planned, sampled, and actual number of respondents for the study by experimental conditions. Non-uniform allocation frequencies are the result of the purposeful design of allocation probabilities. For the analysis we retained only subjects that chose a climate policy in both choice tasks (see column (4) of Table 2), i.e. we excluded those who either chose option *NONE* or the "Don't know / No answer" option in one of their choices. Table C2 shows no significant difference across experimental conditions for most socio-demographic characteristics. The sample is a broad cross-section of the German population, but it is not representative. Subjects in our sample tend to be older and more educated (see Table C1 in the Appendix). This is partly due to the sampling strategy as we sampled only adults.

Table 2: Planned and Sampled Number of Individuals by Experimental Condition, and the respective Number of Completes.

Condition	(1) Planned	(2) Sampled	(3) Completed survey	(4) Chose climate policy in $d = 1$ and $d = 2$
BASE	600	644	595	484
MARKET	400	446	397	331
SHAME	400	459	405	346
REFORM	400	452	404	330
Total	1,800	2,001	1,801	1,491

Column (3) lists the counts net of individuals who refused to participate or dropped out at some point of the survey. Column (4) lists only individuals who chose a climate policy in both $d = 1$ and $d = 2$.

3 General Decision-Making

Before investigating the role of motivated reasoning in the choice of climate policy instruments, this section analyzes the general pattern of decision-making in the discrete-choice task. Table 3 descriptively shows respondents' choices in their first and second decision, including options *NONE* and "Don't know / No answer". Across all treatment groups,

there appears to be a strong preference for *MIX*, particularly in their first decision. Between 5.7 % (group *SHAME*, $d = 2$) and 9.7 % (group *REFORM*, $d = 1$) opt for *NONE* and 5.9 % (group *SHAME*, $d = 1$) to 10.4 % (group *REFORM*, $d = 2$) choose "Don't know / No Answer".

Table 3: Descriptive Statistics on Choices

	ETS	COAL	MIX	NONE	No Answer	Total
d = 1						
BASE	114	112	270	56	43	595
	19.2%	18.8%	45.4%	9.4%	7.2%	100%
MARKET	98	71	172	26	30	397
	24.7%	17.9%	43.3%	6.5%	7.6%	100%
SHAME	77	70	206	28	24	405
	19.0%	17.3%	50.9%	6.9%	5.9%	100%
REFORM	119	46	173	39	27	404
	29.5%	11.4%	42.8%	9.7%	6.7%	100%
Total	**408**	**299**	**821**	**149**	**124**	**1,801**
	22.7%	**16.6%**	**45.6%**	**8.3%**	**6.9%**	**100%**
d = 2						
BASE	220	60	212	44	59	595
	37.0%	10.1%	35.6%	7.4%	9.9%	100%
MARKET	174	38	121	23	41	397
	43.8%	9.6%	30.5%	5.8%	10.3%	100%
SHAME	168	28	146	23	40	405
	41.5%	6.9%	36.0%	5.7%	9.9%	100%
REFORM	93	60	174	35	42	404
	23.0%	14.9%	43.1%	8.7%	10.4%	100%
Total	**655**	**186**	**653**	**125**	**182**	**1,801**
	36.4%	**10.3%**	**36.3%**	**6.9%**	**10.1%**	**100%**

Because the main interest of our analysis is in how information provision affects individuals' choices between different climate policy instruments, we exclude respondents who did not choose a climate policy instrument in either $d = 1$ or $d = 2$. For each climate policy option *ETS*, *COAL*, and *MIX* and each decision $d = 1, 2$ we define a dummy variable that takes on the value one if the respective option was chosen and is zero if any of the other two climate policies was chosen.

Since large parts of the population are not familiar with the EU ETS (Jarke-Neuert

et al., 2023) and previous research has pointed towards a preference for command-and-control over market-based environmental policies (Kirchgässner and Schneider, 2003; Stadelmann-Steffen, 2011), a first natural hypothesis is that without additional information on the climate effectiveness of the policies most respondents would prefer either the concrete option *COAL* – reducing emissions from a coal-fired power plant – or the balanced option *MIX*, i.e. the combination of retirement of allowances from the EU ETS and reduction of emissions from a coal-fired power plant. The latter potentially creates the impression to be on the save side by hedging one's bets or going for the middle ground. In other words, in the baseline condition the share of respondents choosing option *ETS* in their first decision should be below one third. The first column of Table 4 shows results from the estimation of a null logit model on the probability of choosing option *ETS* in their first decision for the baseline condition. The share of respondents choosing to retire allowances from the EU ETS (option *ETS*) is 23.1 %, which is clearly below one third. However, since with 22.9 %, the share of respondents who choose option *COAL* is virtually the same, this result is more likely to be driven by a preference for the seemingly save option *MIX* than by an aversion against *ETS*.

Table 4: Causal Effect of Information Provision in *BASE*. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)		(3)		(4)	
Dependent variable	*ETS*		*COAL*		*ETS*		*COAL*	
$d = 1$ margin	0.231	$(0.019)^{***}$	0.229	$(0.019)^{***}$	0.231	$(0.019)^{***}$	0.229	$(0.019)^{***}$
$d = 2$ effect					0.221	$(0.020)^{***}$	-0.105	$(0.017)^{***}$
# observations	484		484		968		968	
$\log \mathscr{L}$	-261.83		-260.62		-595.12		-442.00	
Wald χ^2					107.89		35.61	
Wald p					0.000		0.000	
Pseudo R^2	0.000		0.000		0.043		0.020	

Predictive margins for $d = 1$ and average marginal effects of the respective discrete change of d relative to $d = 1$. In parentheses are the standard errors clustered at the individual level. Column (1) contains only half of the observations from columns (2) and (3), because it only investigates the first decision. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$).

Beliefs about the effects of an environmental policy have been found to be crucial determinants of voter support (Drews and Van den Bergh, 2016; Millner and Ollivier, 2016; Rinscheid and Wüstenhagen, 2018). Therefore, when deciding between different – at least to them – equally costly climate policy instruments, we expect individuals to choose the instrument that they believe to be most effective or whose financial impact they find most appealing – see Appendix A and questions D.11 and D.14 in Appendix D for a detailed description of these beliefs and how they were elicited. This assumption is investigated in Table 5, where we use a multinomial logit model to test the correlation between the likelihood of choosing a specific mitigation option in their first choice for subjects in conditions *BASE*, *MARKET*, and *SHAME*, and their ranking of these options in terms of effectiveness and financial impact. The independent variables are dummy variables for considering a given option as single most effective or financially most preferred. All columns originate from the same multinomial logit estimation and each column shows the marginal effects on the likelihood of choosing a given policy option. There is indeed a positive and statistically significant relationship between beliefs about effectiveness and the likelihood of choosing a specific climate policy. Respondents seem to value effectiveness substantially more than financial impact, as the marginal effects of effectiveness ranking are always significantly larger than those of financial impact and the correlation with preferred financial impact is not always statistically significant.

The *REFORM* condition differs from all other experimental conditions in the sense that respondents receive information on the effect of each option on total CO_2 emissions under the current rules of the EU ETS before making their first decision ($d = 1$). Before their second decision, $d = 2$, respondents in this condition are informed that under a proposed reform of the EU ETS all options would be equally effective in reducing CO_2 emissions. Table 6 uses a multinomial logit estimation to test how the information on

Table 5: Correlation of Decisions with Beliefs about Effectiveness and Preferences over Financial Impacts in *BASE*, *MARKET*, *SHAME* on $d = 1$. Average Marginal Effects from a Multinomial Logit Estimation with Option *MIX* as Base Outcome.

	(1)		(2)		(3)	
Dependent variable	*ETS*		*COAL*		*MIX*	
Overall margin	0.250	$(0.010)^{***}$	0.217	$(0.011)^{***}$	0.533	$(0.013)^{***}$
Effect of belief about single most effective option						
Option *ETS*	0.430	$(0.049)^{***}$	-0.131	$(0.037)^{***}$	-0.298	$(0.052)^{***}$
Option *COAL*	-0.166	$(0.036)^{***}$	0.351	$(0.049)^{***}$	-0.185	$(0.053)^{***}$
Option *MIX*	-0.196	$(0.032)^{***}$	-0.156	$(0.033)^{***}$	0.351	$(0.040)^{***}$
Effect of being considered single financially most preferred option						
Option *ETS*	0.123	$(0.031)^{***}$	-0.049	(0.032)	-0.074	$(0.038)^{*}$
Option *COAL*	-0.021	(0.045)	0.085	$(0.047)^{*}$	-0.064	(0.054)
Option *MIX*	-0.018	(0.040)	-0.032	(0.037)	0.051	(0.049)

Regression controlling for gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms. Overall margin is the total predicted share of study participants who chose the respective option. $n = 893$, $\log \mathscr{L} = -555.45$, Wald $\chi = 411.96$, Wald $p = 0.000$, pseudo $R^2 = 0.386$. In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$).

the proposed reform impacts the likelihood of choosing each policy option over the other two. Further, it tests whether preferences over financial impacts have a different effect on the likelihood of choosing a given option under the proposed reform than under the current rules.

The results in Table 6 show that the information about the proposed reform leads to a statistically significant decrease of 7.6 percentage points in the probability of choosing option *ETS* – which is most effective under the current rules. Simultaneously, the share of respondents choosing option *COAL* – the avoidance of emissions from a coal-fired power-plant – significantly increases by 4.5 percentage points. The increase of 3.0 percentage points in the probability of choosing option *MIX* is not statistically significant. These results reveal an increased preference for concrete over abstract climate policies or a concern for local externalities, such as local air pollution by coal-fired power plants, provided that both policies are equally effective in reducing total CO_2 emissions.

One might expect that when all three policies are equally effective, decisions should

be more strongly correlated with preferences over financial impacts. This hypothesis, however, is only partially confirmed by our data (see Table 6). The correlation with preferences over financial impacts is significantly stronger for option *COAL* in the second decision, but significantly weaker for option *MIX* and not statistically different for *ETS*.

Table 6: Correlation of Decisions with Preferences over Financial Impacts Under Different Information about Effectiveness in *REFORM*. Average Marginal Effects from a Multinomial Logit Estimation with Option *MIX* as Base Outcome.

	(1)		(2)		(3)	
Dependent variable	*ETS*		*COAL*		*MIX*	
Overall margin at $d = 1$	0.371	$(0.017)***$	0.148	$(0.017)^{***}$	0.481	$(0.025)^{***}$
$d = 2$ effect	−0.076	$(0.022)^{***}$	0.045	$(0.019)^{**}$	0.030	(0.025)
Effect of being considered single financially most preferred option at $d = 1$						
Option *ETS*	0.150	$(0.078)^{*}$	−0.041	(0.035)	−0.109	(0.078)
Option *COAL*	−0.121	(0.077)	0.298	$(0.080)^{***}$	−0.177	$(0.088)^{**}$
Option *MIX*	−0.220	$(0.072)^{***}$	0.012	(0.039)	0.209	$(0.079)^{***}$
Effect of being considered single financially most preferred option at $d = 2$						
Option *ETS*	0.145	$(0.074)^{*}$	−0.058	(0.052)	−0.087	(0.081)
Option *COAL*	−0.124	$(0.065)^{*}$	0.372	$(0.090)^{***}$	−0.248	$(0.090)^{***}$
Option *MIX*	−0.184	$(0.059)^{***}$	0.010	(0.054)	0.174	$(0.076)^{**}$

Estimates derived from a maximum likelihood logit estimation controlling for gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, beliefs about effectiveness, attitude towards the market economy, and attitude towards big firms. Overall margin is the total predicted share of study participants who choose the respective option. $n = 528$, $\log \mathscr{L} = -332.79$, Wald $\chi = 516.14$, Wald $p = 0.000$, pseudo $R^2 = 0.379$. In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$).

Another hypothesis is that framing the EU ETS as an instrument restricting markets (as opposed to a market-based instrument) would increase its acceptance among respondents who dislike the market economy. If this were the case, a larger share of respondents with a negative attitude towards the market economy should choose to reduce emissions either via the retirement of allowances from the EU ETS or via the combined option *MIX* in their first decision ($d = 1$) in the *MARKET* condition than in the baseline condition.[6] Table 7 investigates this hypothesis by regressing the likelihood of choosing *ETS* and the

[6]The pre-registered hypothesis is slightly different in that it does not mention that the effect of the *MARKET* treatment should depend on the respondents' attitude towards the market economy. The results for the pre-registered hypothesis can be found in Table C4 in Appendix C.

combined likelihood of choosing either *ETS* or *MIX* on a dummy for having a very or rather negative attitude towards the market economy, a dummy for the *MARKET* treatment, and their interaction. Column (1) shows that framing the ETS as an instrument that restricts markets increases the probability that respondents who have a negative attitude towards the market economy choose this option by 15.5 percentage points. However, this effect is only marginally significant. Further, there is no significant effect on the combined likelihood of choosing either *ETS* or *MIX* (see column (2) of Table 7).

Table 7: Impact of *MARKET* Condition on $d = 1$. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)	
Dependent variable	*ETS*		*ETS + MIX*	
BASE margin	0.240	$(0.020)^{***}$	0.777	$(0.020)^{***}$
Effect of negative attitude towards markets	0.056	(0.049)	−0.061	(0.049)
MARKET effect:				
At negative attitude	0.155	$(0.094)^{*}$	0.086	(0.090)
At positive/neutral attitude	−0.035	(0.036)	0.013	(0.033)
Covariates	Yes		Yes	
# observations	716		716	
$\log \mathscr{L}$	−392.65		−360.40	
Wald χ^2	34.42		21.84	
Wald p	0.003		0.112	
Pseudo R^2	0.043		0.030	

In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates are gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

Finally, for individuals who care about climate change mitigation, the information about the effectiveness of mitigation options provided before their second decision is relevant and should induce at least some to adjust their choices in line with the information received. Thus, in the baseline condition more respondents should choose option *ETS* – the most effective option – in their second decision, $d = 2$, than in their first decision and the share of those choosing option *COAL* – the least effective option – should be reduced

in $d = 2$ compared to $d = 1$. This assumption is tested in columns (2) and (3) of Table 4, where the likelihood of choosing option *ETS* (column (2)) or option *COAL* (column (3)) is regressed on a dummy variable for the second decision. The expectation is clearly confirmed. In the second decision, where information about the effectiveness ranking of options is provided, the share of respondents who chose the most effective option *ETS* is significantly higher by 22.1 percentage points than in the first decision, whereas the share of the least effective option *COAL* is significantly reduced by 10.5 percentage points. These results are robust to the inclusion of socio-demographic control variables (see Table C3) and can be taken as evidence of rational belief updating.

4 The Role of Motivated Reasoning in Decisions About Climate Policy

The introduction in the *SHAME* condition included a short statement stressing the importance of coal combustion for CO_2 emissions and explained that emissions from coal-fired power plants had increased in the year before the survey. A natural hypothesis is that this information induces an urge to hold operators of coal-fired power plants responsible for climate protection, leading to a higher share of individuals in *SHAME* choosing option *COAL* or option *MIX* in their first decision as compared to the baseline condition. Table 8 investigates this assumption by regressing the likelihood of choosing option *COAL* and the combined likelihood of choosing either option *COAL* or option *MIX* in the first decision $d = 1$, when no information about the effectiveness of the options is provided, on a treatment dummy variable for the *SHAME* condition. While the effect on choosing either option *COAL* or option *MIX* is positive, it is small and statistically not different from zero. The effect on the likelihood of choosing option *COAL*, which would be the most direct way to hold operators of coal-fired power plants accountable for their emissions, is negative but also not statistically different from zero. Since it is irrelevant for climate

change mitigation in which sector emissions are saved, it is rational not to respond to the framing in condition *SHAME*.

Table 8: Impact of *SHAME* Condition in $d = 1$. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)		(3)		(4)	
Dep. variable	*COAL*		*COAL + MIX*		*COAL*		*COAL + MIX*	
BASE margin	0.229	$(0.019)^{***}$	0.769	$(0.019)^{***}$	0.222	$(0.020)^{***}$	0.761	$(0.020)^{***}$
SHAME effect	-0.030	(0.029)	0.018	(0.029)	-0.016	(0.031)	0.016	(0.031)
Covariates	No		No		Yes		Yes	
# observations	830		830		733		733	
$\log \mathscr{L}$	-433.48		-441.42		-372.27		-376.14	
Wald χ^2	1.06		0.36		19.91		38.70	
Wald p	0.303		0.551		0.133		0.000	
Pseudo R^2	0.001		0.000		0.026		0.053	

In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates include gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

The *SHAME* condition was designed to test whether motivated reasoning plays a role in individuals' decisions about climate policy instruments. The statement in *SHAME* emphasizing the relevance of coal combustion for CO_2 emissions may lead to the perception that the reduction of emissions from a coal-fired power plant is a particularly fair approach for climate change mitigation. This impression then conflicts with the information provided before the second decision that reducing the cap in the EU ETS is the most effective measure. Therefore, our first main hypothesis on motivated reasoning is that in the *SHAME* condition provision of information on the effectiveness of climate policy instruments should be less likely than in the baseline condition to induce an adjustment of choices in line with the information provided. Specifically, providing information should induce a smaller reduction in *SHAME* than in *BASE* in the probability that the least effective option (*COAL*) is chosen relative to all mitigation options. This hypothesis can be tested by regressing the likelihood of choosing option *COAL* on a treatment dummy for

SHAME, a dummy for the second decision $d = 2$, and their interaction. Table 9 shows the marginal effects from maximum likelihood logit estimations. Column (2) includes socio-demographic control variables. In contrast to what was hypothesized, information provision at $d = 2$ appears to generate larger reductions in the likelihood of choosing the least effective option in the *SHAME* condition (13.2 percentage points) than in the baseline condition (10.2 percentage points). Although this difference is not statistically significant, this implies that the hypothesis is clearly rejected and provides further evidence for rational belief-updating.

Table 9: Motivated Reasoning in the *SHAME* Condition. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)	
Dependent variable	Option *COAL*		Option *COAL*	
Reference margin	0.230	$(0.0191)^{***}$	0.223	$(0.020)^{***}$
SHAME effect	-0.036	$(0.021)^{*}$	-0.033	(0.022)
$d = 2$ effect:				
At *BASE*	-0.105	$(0.017)^{***}$	-0.102	$(0.018)^{***}$
At *SHAME*	-0.118	$(0.021)^{***}$	-0.132	$(0.023)^{***}$
Covariates	No		Yes	
# observations	1,660		1,466	
$\log \mathscr{L}$	-712.10		-608.99	
Wald χ^2	66.69		76.27	
Wald p	0.000		0.000	
Pseudo R^2	0.030		0.049	

Reference margin is the first decision ($d = 1$) of respondents in condition *BASE*. *SHAME* effect is the average partial effect of being assigned to the *SHAME* condition compared to the *BASE* condition. In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates include gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

While the first main hypothesis investigates the prevalence of motivated reasoning induced by an exogenous treatment, the second main hypothesis focuses on identification with the anti-coal movement as a potential source of motivated reasoning. Identification with the anti-coal movement is measured by self-reported participation in protests against coal combustion and coal mining during the last five years. For respondents who

participated in protests related to phasing out coal, the information that reducing emissions from a coal-fired power plant is the least effective climate policy instrument is likely to conflict with their prior beliefs. According to the theory of motivated reasoning, this should impede belief updating. Thus, within the baseline condition respondents that state to have participated in protests related to phasing out coal or extracting coal are expected to respond less to information on the relative ineffectiveness of directly reducing emissions by coal-fired power plants. In particular, the reduction in the likelihood of choosing option *COAL* or option *MIX* from $d = 1$ to $d = 2$ should be smaller for respondents who participated in protests.

Table 10: Motivated Reasoning and Participation in Protests in *BASE*. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)	
Dependent variable	Option *COAL*		Option *MIX*	
Reference margin	0.213	$(0.020)^{***}$	0.543	$(0.024)^{***}$
Effect of coal protests	0.117	(0.086)	-0.205	$(0.092)^{**}$
$d = 2$ effect:				
At *coal protest* $= 0$	-0.091	$(0.018)^{***}$	-0.113	$(0.023)^{***}$
At *coal protest* $= 1$	-0.356	$(0.112)^{***}$	-0.157	(0.110)
Covariates	Yes		Yes	
# observations	856		856	
$\log \mathscr{L}$	-373.18		-558.14	
Wald χ^2	49.72		57.80	
Wald p	0.000		0.000	
Pseudo R^2	0.053		0.058	

Reference margin is decision at $d = 1$ by respondents who didn't participate in protests against coal. Effect of coal protests is the average partial effect of having participated in protests against coal. In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates include gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

Table 10 tests this hypothesis by regressing the likelihood of choosing option *COAL* (see column (1)) or option *MIX* (see column (2)) on a dummy for $d = 2$, a binary indicator for having participated in protests related to phasing out coal, and their interaction. Contrary to what was hypothesized, the reduction in the likelihood of choosing to reduce

emissions from a coal-fired power plant (*COAL*) is significantly larger for individuals who state to have participated in anti-coal protests. While respondents who had participated in protests are 35.6 percentage points less likely to choose option *COAL* after being informed that this option is least effective, the reduction is only 9.1 percentage points among those who did not participate in protests. Remarkably, the treatment effect among protesters is not a mere levelling effect compensating their higher likelihood of choosing option *COAL* when not being informed about its relative ineffectiveness. Instead, the information treatment leads to protesters being less likely to choose the least effective option than those who did not protest against coal.

Similarly, the reduction in the likelihood of choosing the combined mitigation option (*MIX*) is 15.7 percentage points for individuals who participated in protests and only 11.3 percentage points for those who did not. These coefficients, however, are not different from each other in statistical terms. Although the results for this hypothesis have to be interpreted with caution, as only 27 respondents in *BASE* participated in protests against coal, they can again be taken as evidence for rational belief-updating and against motivated reasoning.[7]

5 Conclusion

In a consequential online experiment, we find that individuals make rational choices and tend to choose climate policies that they consider more effective. Moreover, they respond to information about the effects of the mitigation options on total emissions in the EU. This indicates that the EU ETS is not yet well-understood (see Jarke-Neuert et al., 2023). When all climate policies are equally effective, as would be the case under a proposed re-

[7]We further pre-registered heterogeneity analyses of the two main hypotheses with respect to residency in active and recently abandoned coal/lignite mining regions or the primary trading area of STEAG GmbH. As STEAG GmbH has no private customers, less than 15 respondents lived in active or recently abandoned mining regions, and the analysis of the main hypotheses did not show the expected effects, we abstain from those heterogeneity analyses.

form of the EU ETS, individuals tend to favor concrete policies, i.e. the reduction of emissions from a coal-fired power plant, over abstract policies, such as abatement through the cancellation of emission allowances. Additionally, we find tentative evidence that respondents who have a negative attitude towards the market economy prefer policies that grant the government direct control over total emissions as they were slightly more likely to choose emission reduction through the ETS when framed in this way.

We do not find evidence for motivated reasoning in the decision between different climate policies. Firstly, study participants do not respond to a treatment emphasizing the contribution of coal-fired power plants to overall CO_2 emissions. Additionally, they remain equally responsive to information about the effectiveness of the different policies after this framing is provided. Secondly, motivated reasoning theory predicts that respondents who participated in protests related to phasing out coal – a strong indicator of identifying as an anti-coal activist – should be less likely to react to the information indicating that reducing emissions from a coal-fired power plant is the least effective way to reduce overall emissions. However, our findings show the opposite result. This suggests that individuals participating in protests against coal combustion may generally be more concerned about climate change and, thus, more responsive to information about effective climate policies. However, contrary to the hypothesis, they do not appear to have a specific emotional connection to any particular climate policy.

This confirms the findings of Jarke-Neuert et al. (2023), who found no evidence for motivated reasoning among supporters of climate action. By contrast, Douenne and Fabre (2022) detected behavior that might be consistent with motivated reasoning among opponents of climate action. This suggests that opponents of climate policy may be more susceptible to motivated reasoning than supporters – a result that is similar to a recent finding by Rathje et al. (2023), who observe more politically motivated reasoning among

US conservatives than liberals. Our findings suggest that educating individuals on the relative effectiveness of different climate policies can increase support for effective climate policies, such as a cap-and-trade system or a carbon tax.

References

Akerlof, G. A. and Kranton, R. E. (2000). Economics and identity. *The Quarterly Journal of Economics*, 115(3):715–753.

Bago, B., Rand, D. G., and Pennycook, G. (2023). Reasoning about climate change. *PNAS nexus*, 2(5):pgad100.

Barron, K. (2021). Belief updating: does the 'good-news, bad-news' asymmetry extend to purely financial domains? *Experimental Economics*, 24(1):31–58.

Bénabou, R. and Tirole, J. (2002). Self-confidence and personal motivation. *The Quarterly Journal of Economics*, 117(3):871–915.

Bolte, L. and Fan, T. Q. (2024). Motivated mislearning: The case of correlation neglect. *Journal of Economic Behavior & Organization*, 217:647–663.

Borghesi, S., Pahle, M., Perino, G., Quemin, S., and Willner, M. (2023). The market stability reserve in the EU emissions trading system: a critical review. *Annual Review of Resource Economics*, 15:131–152.

Carattini, S., Kallbekken, S., and Orlov, A. (2019). How to win public support for a global carbon tax. *Nature*, 565(7739):289–291.

Castagnetti, A. and Schmacker, R. (2022). Protecting the ego: Motivated information selection and updating. *European Economic Review*, 142:104007.

Chew, S. H., Huang, W., and Zhao, X. (2020). Motivated false memory. *Journal of Political Economy*, 128(10):3913–3939.

Coutts, A. (2019). Good news and bad news are still news: Experimental evidence on belief updating. *Experimental Economics*, 22(2):369–395.

Douenne, T. and Fabre, A. (2022). Yellow vests, pessimistic beliefs, and carbon tax aversion. *American Economic Journal: Economic Policy*, 14(1):81–110.

Drews, S. and Van den Bergh, J. C. (2016). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy*, 16(7):855–876.

Druckman, J. N. and McGrath, M. C. (2019). The evidence for motivated reasoning in climate change pref-

erence formation. *Nature Climate Change*, 9(2):111–119.

Ende Gelände (2023). Sofortprogramm Klimagerechtigkeit. https://www.ende-gelaende.org/sofortprogramm-klimagerechtigkeit/. Accessed on September 5, 2023.

Ertac, S. (2011). Does self-relevance affect information processing? Experimental evidence on the response to performance and non-performance feedback. *Journal of Economic Behavior & Organization*, 80(3):532–545.

European Commission (2021). COMMISSION STAFF WORKING DOCUMENT, IMPACT ASSESSMENT REPORT, Accompanying the document DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757. SWD(2021) 601 final PART 1 of 4, Brussels, 14.7.2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0601, last access December, 2023.

Fransen, T., Meckling, J., Stünzi, A., Schmidt, T. S., Egli, F., Schmid, N., and Beaton, C. (2023). Taking stock of the implementation gap in climate policy. *Nature Climate Change*, 13(8):752–755.

Fridays for Future (2023). We must end the era of fossil fuels. https://fridaysforfuture.org/september15/.Accessed on September 5, 2023.

Frondel, M., Matejko, L., Osberghaus, D., Sommer, S., and Vance, C. (2023). Green SÖP extended: The socio-ecological panel surveys 2020 and 2022. *Jahrbücher für Nationalökonomie und Statistik*, 243(5):567–583.

Ganguly, A. and Tasoff, J. (2017). Fantasy and dread: The demand for information and the consumption utility of the future. *Management Science*, 63(12):4037–4060.

Gerlagh, R. and Heijmans, R. J. (2019). Climate-conscious consumers and the buy, bank, burn program. *Nature Climate Change*, 9(6):431–433.

Hutmacher, F., Reichardt, R., and Appel, M. (2022). The role of motivated science reception and numeracy in the context of the covid-19 pandemic. *Public Understanding of Science*, 31(1):19–34.

Jarke-Neuert, J., Perino, G., Flörchinger, D., and Frondel, M. (2023). Minimum effective information in allowance cancelling. *USAEE Working Paper*, 23-584.

Kahan, D. M. (2013). Ideology, motivated reasoning, and cognitive reflection. *Judgment and Decision Making*, 8(4):407–424.

Kirchgässner, G. and Schneider, F. (2003). On the political economy of environmental policy. *Public Choice*, 115(3-4):369–396.

Klick, L., Kussel, G., and Sommer, S. (2021). Green-SÖP: The socio-ecological panel survey: 2012–2016. *Jahrbücher für Nationalökonomie und Statistik / Journal of Economics and Statistics*, 241(3):405–414.

Kohleausstiegsgesetz (2020). Gesetz zur Reduzierung und zur Beendigung der Kohleverstromung und zur Änderung weiterer Gesetze (Kohleausstiegsgesetz). *Bundesgesetzblatt*, (37):1818–1867.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, 108(3):480.

Kuzmanovic, B., Rigoux, L., and Tittgemeyer, M. (2018). Influence of vmpfc on dmpfc predicts valence-guided belief formation. *Journal of Neuroscience*, 38(37):7996–8010.

Le Yaouanq, Y. (2023). A model of voting with motivated beliefs. *Journal of Economic Behavior & Organization*, 213:394–408.

Lecocq, F., Winkler, H., Daka, J. P., Fu, S., Gerber, J. S., Kartha, S., Krey, V., Lofgren, H., Masui, T., Mathur, R., Portugal-Pereira, J., Sovacool, B. K., Vilarino, M. V., and Zhou, N. (2022). 2022: Mitigation and development pathways in the near- to mid-term. In Skea, J., Slade, R., Khourdajie, A. A., van Diemen, R., McCollum, D., Pathak, M., Some, S., Vyas, P., Fradera, R., Belkacemi, M., Hasija, A., Lisboa, G., Luz, S., and Malley, J., editors, *IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P. R. Shukla*.]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Liersch, C. and Stegmaier, P. (2022). Keeping the forest above to phase out the coal below: The discursive politics and contested meaning of the Hambach Forest. *Energy Research & Social Science*, 89:102537.

Liu, P. R. and Raftery, A. E. (2021). Country-based rate of emissions reductions should increase by 80% beyond nationally determined contributions to meet the 2°C target. *Communications Earth & Environment*, 2(1):29.

Luo, Y. and Zhao, J. (2019). Motivated attention in climate change perception and action. *Frontiers in Psychology*, 10:1541.

Machin, A. (2019). Changing the story? The discourse of ecological modernisation in the European Union. *Environmental Politics*, 28(2):208–227.

Markard, J., Rinscheid, A., and Widdel, L. (2021). Analyzing transitions through the lens of discourse networks: Coal phase-out in Germany. *Environmental Innovation and Societal Transitions*, 40:315–331.

Millner, A. and Ollivier, H. (2016). Beliefs, politics, and environmental policy. *Review of Environmental Economics and Policy*.

Möbius, M. M., Niederle, M., Niehaus, P., and Rosenblat, T. S. (2022). Managing self-confidence: Theory and

experimental evidence. *Management Science*, 68(11):7793–7817.

Munro, G. D. and Stansbury, J. A. (2009). The dark side of self-affirmation: Confirmation bias and illusory correlation in response to threatening information. *Personality and Social Psychology Bulletin*, 35(9):1143–1153.

Oster, E., Shoulson, I., and Dorsey, E. R. (2013). Optimal expectations and limited medical testing: Evidence from huntington disease. *American Economic Review*, 103(2):804–830.

Our World in Data (2023). Germany: Per capita: how much CO_2 does the average person emit? https://ourworldindata.org/grapher/consumption-co2-per-capita?tab=table&country=~DEU.Accessed on June 1, 2023.

Perino, G. (2018). New EU ETS Phase 4 rules temporarily puncture waterbed. *Nature Climate Change*, 8(4):262–264.

Perino, G., Jarke-Neuert, J., Schenuit, F., Wickel, M., and Zengerling, C. (2022a). Closing the implementation gap: Obstacles in reaching net-zero pledges in the eu and Germany. *Politics and Governance*, 10(3).

Perino, G., Willner, M., Quemin, S., and Pahle, M. (2022b). The European Union emissions trading system market stability reserve: does it stabilize or destabilize the market? *Review of Environmental Economics and Policy*, 16(2):338–345.

Rathje, S., Roozenbeek, J., Van Bavel, J. J., and van der Linden, S. (2023). Accuracy and social motivations shape judgements of (mis) information. *Nature Human Behaviour*, pages 1–12.

Reuters (2022). Germany's cabinet approves accelerated coal exit by 2030 in western state. https://www.reuters.com/business/energy/germanys-cabinet-approves-accelerated-coal-exit-by-2030-western-state-2022-11-02/. Accessed on February 18, 2024.

Rinscheid, A. and Wüstenhagen, R. (2018). Divesting, fast and slow: Affective and cognitive drivers of fading voter support for a nuclear phase-out. *Ecological Economics*, 152:51–61.

Ripberger, J. T., Jenkins-Smith, H. C., Silva, C. L., Carlson, D. E., Gupta, K., Carlson, N., and Dunlap, R. E. (2017). Bayesian versus politically motivated reasoning in human perception of climate anomalies. *Environmental Research Letters*, 12(11):114004.

Rivers, N., Woerman, M., and Yassin, K. (2023). Yellow vests, pessimistic beliefs, and carbon tax aversion (2022): A comment. *I4R Discussion Paper Series*, (58).

Rogelj, J., Fransen, T., den Elzen, M. G., Lamboll, R. D., Schumer, C., Kuramochi, T., Hans, F., Mooldijk,

S., and Portugal-Pereira, J. (2023). Credibility gap in net-zero climate targets leaves world at high risk. *Science*, 380(6649):1014–1016.

Stadelmann-Steffen, I. (2011). Citizens as veto players: climate change policy and the constraints of direct democracy. *Environmental Politics*, 20(4):485–507.

Statistisches Bundesamt (31.03.2023). Statistischer Bericht. Mikrozensus - Haushalte und Familien. Erstergebnisse 2022. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Haushalte-Familien/Publikationen/Downloads-Haushalte/statistischer-bericht-mikrozensus-haushalte-familien-2010300227005-erstergebnisse.html.

Thaler, M. (2021). Gender differences in motivated reasoning. *Journal of Economic Behavior & Organization*, 191:501–518.

Treibhausgasemissionsgesetz (2011). Gesetz über den Handel mit Berechtigungen zur Emission von Treibhausgasen (Treibhausgas-Emissionshandelsgesetz – TEHG). *Bundesgesetzblatt*, (38):1475–1502.

UNEP (2023). *Broken Record: Emissions Gap Report 2023*. United Nations Environment Programme.

Yao, Z., Lin, X., and Hu, X. (2021). Optimistic amnesia: how online and offline processing shape belief updating and memory biases in immediate and long-term optimism biases. *Social Cognitive and Affective Neuroscience*, 16(5):453–462.

Zappalà, G. (2023). Drought exposure and accuracy: Motivated reasoning in climate change beliefs. *Environmental and Resource Economics*, pages 1–24.

Zhou, J. (2016). Boomerangs versus javelins: How polarization constrains communication on climate change. *Environmental Politics*, 25(5):788–811.

Zimmermann, F. (2020). The dynamics of motivated beliefs. *American Economic Review*, 110(2):337–363.

Appendix

A Attitudes and Beliefs related to Climate Policy and Economic Aspects

Immediately before the decision tasks, we elicited the respondents' attitudes towards the market economy and big firms, as well as their participation in protests for climate protection and protests against coal during the last five years, as these attitudes and beliefs might be relevant for their choices in the tasks. Further, we elicited beliefs about the effectiveness and financial impact of the three climate policy options during the experiment. This section provides a suite of descriptive statistics on these attitudes and beliefs.

Table A1 demonstrates that the majority of almost 60 % of the respondents has a very positive or rather positive attitude towards the market economy, with only 13.7 % being critical. Big firms are perceived less positively: about 25 % of the respondents express a very negative or rather negative attitude, with the majority of about 55 % of the respondents being neutral.

Table A1: Attitudes Towards Big Firms and Market Economy.

Item	Very negative	Rather negative	Neutral	Rather positive	Very positive	n/a	Total
Market economy	14	208	426	776	198	9	1631
	0.9 %	12.8 %	26.1 %	47.6 %	12.1 %	0.6 %	100 %
Big firms	35	369	904	297	21	5	1631
	2.1 %	22.6 %	55.4 %	18.2 %	1.3 %	0.3 %	100 %

Table A2 shows that only 10.0 % of the respondents engaged in climate protests during the last five years. Participation in protests against coal was even lower: only 4.0 % of the respondents engaged in such protests.

After the first decision, $d = 1$, respondents were asked to rank the three mitigation options *ETS*, *COAL*, and *MIX* according to their perception on the effectiveness of these options (see question D.11 in Appendix D). The descriptive results on these perceptions

Table A2: Participation in Protests during the Last 5 Years.

Item	Never	Once or twice	More than twice	n/a	Total
Climate protests	1466	106	57	2	1631
	89.9 %	6.5 %	3.5 %	0.1 %	100 %
Protests against Coal	1563	47	18	3	1631
	95.8 %	2.9 %	1.1 %	0.2 %	100 %

are reported in Table A3. While some respondents rank two or all three instruments as equally effective and 7.9 % refused to indicate a ranking, a large majority of 72.9 % has single-peaked beliefs. There appears to be a clear preference for option *MIX*, the combination of retirement of allowances from the ETS and the reduction of emissions from a coal-fired power plant: 22.7 (group *MARKET*) to 30.3 % of the respondents (group *SHAME* rank this option as single most effective. It bears noting that the effectiveness ranking of mitigation options by subjects from conditions *BASE*, *MARKET*, and *SHAME* in Table A3 is inconsistent with the options' actual effectiveness. This implies that there is scope for learning, which is important for our experiment. Subjects of the *REFORM* condition had already been informed about the actual effectiveness of the three mitigation options prior to the first decision. Indeed, their beliefs about the effectiveness are much more aligned with the actual effectiveness ranking, as 38.5 % rank *ETS* as single most effective, compared to only 19.0 to 24.2 % in the other treatment conditions.

After the second decision $d = 2$, that is, after subjects of conditions *BASE*, *MARKET*, and *SHAME* had been informed about the effectiveness of each option and subjects of condition *REFORM* had been informed about the effectiveness of options under a proposed reform, participants were asked to rank all options according to their preferences over their financial impacts (see question D.14 in Appendix D). Note that we deliberately abstained from providing information on actual financial impacts to mimic real-world decisions, where voters are usually not informed about actual impacts. As with beliefs about effectiveness, the majority of respondents has single-peaked beliefs. With respect

Table A3: Beliefs about the Effectiveness of Mitigation Options *ETS*, *COAL*, and *MIX*.

Belief shape	Description	BASE	MARKET	SHAME	REFORM	Total
Single-peaked	One single instrument ranked first	345	233	250	259	1,087
	ETS ranked first	92	80	73	127	372
	COAL ranked first	110	78	72	51	311
	MIX ranked first	143	75	105	81	404
Double-peaked	Two instruments ranked joint first	37	34	24	23	118
	ETS+COAL ranked first	20	15	10	10	55
	ETS+MIX ranked first	8	10	8	7	33
	COAL+MIX ranked first	9	9	6	6	30
Flat	All instruments equally ranked	64	35	42	27	168
None	Question not answered	38	29	30	21	118
Total		484	331	346	330	1,491
Single-peaked	One single instrument ranked first	71.2%	70.5%	72.2%	78.5%	72.9%
	ETS ranked first	19.0%	24.2%	21.1%	38.5%	24.9%
	COAL ranked first	22.7%	23.6%	20.8%	15.5%	20.9%
	MIX ranked first	29.5%	22.7%	30.3%	24.5%	27.1%
Double-peaked	Two instruments ranked joint first	7.7%	10.2%	6.9%	6.9 %	7.9%
	ETS+COAL ranked first	4.1%	4.5%	2.9%	3.0%	3.7%
	ETS+MIX ranked first	1.7%	3.0%	2.3%	2.1%	2.2%
	COAL+MIX ranked first	1.9%	2.7%	1.7%	1.8%	2.0%
Flat	All instruments equally ranked	13.2%	10.6%	12.1%	8.2%	11.3%
None	Question not answered	7.9%	8.8%	8.7%	6.4%	7.9%
Total		100%	100%	100%	100%	100%

to financial impact, option *ETS*, the retirement of emission allowances is the most popular option, with 34.4 % across all treatment groups ranking it as single most preferred. The combined option *MIX* is also quite popular in this respect, with 25.3 % ranking it as single most preferred.

Table A4: Preferences over Financial Impacts of Options.

Belief Shape	Description	BASE	MARKET	SHAME	REFORM	Total
Single-peaked	One single instrument ranked first	350	241	245	242	1,078
	ETS most preferred	165	132	119	93	509
	COAL most preferred	63	42	39	50	194
	MIX most preferred	122	67	87	99	375
Double-peaked	Two instruments ranked joint first	46	29	32	28	135
	ETS+COAL most preferred	12	9	19	9	49
	ETS+MIX most preferred	23	10	10	11	54
	COAL+MIX most preferred	11	10	3	8	32
Flat	All instruments equally preferred	39	27	28	29	123
None	Question not answered	47	32	38	27	144
Total		482	329	343	326	1,480
Single-peaked	One single instrument ranked first	72.6%	73.3%	71.5%	74.2%	72.8%
	ETS single most preferred	34.2%	40.1%	34.7%	28.5%	34.4%
	COAL single most preferred	13.1%	12.8%	11.4%	15.3%	13.1%
	MIX single most preferred	25.3%	20.4%	25.4%	30.4%	25.3%
Double-peaked	Two instruments ranked joint first	9.6%	8.7%	9.3%	8.7%	9.1%
	ETS+COAL most preferred	2.5%	2.7%	5.5%	2.8%	3.3%
	ETS+MIX most preferred	4.8%	3.0%	2.9%	3.4%	3.6%
	COAL+MIX most preferred	2.3%	3.0%	0.9%	2.5%	2.2%
Flat	All instruments equally preferred	8.1%	8.2%	8.2%	8.9%	8.3%
None	Question not answered	9.8%	9.7%	11.1%	8.3%	9.7%
Total		100%	100%	100%	100%	100%

B Impact of Options on Total CO_2 Emissions in the EU

Table B1: Effectiveness of options in reducing total CO_2 emissions in the EU

Options	**Description**	**Expected Effectiveness**	**Uncertainty due to fit for 55 if European Commission proposal adopted**
ETS	Retire 10 EUAs using the "buy, bank burn" strategy	100%; 10 tons reduction	None. Reduction: 10 tons
COAL	Reduce emissions of a coal-fired power plant by 10 tons of CO_2	$100 - W\% = 42\%$; 4.2 tons reduction	High upward risk. Reduction: 10 tons
MIX	Reduce emissions of a coal-fired power plant by 5 tons of CO_2 and retire 5 EUAS using the "buy, bank, burn" strategy.	7.1 tons reduction (average of *ETS* and *COAL*	High upward risk. Reduction: 10 tons

W is the waterbed effect. For immediate interventions it is strictly between $0 - 100\%$ under the regulatory setting in place in 2022.

Underlying assumptions:

- Total number of allowances in circulation (TNAC) drops below 833 million during 2024 (see European Commission, 2021, Figure 3), i.e. after the experimental intervention in 2022 there are two more years the TNAC triggers automatic cancellations of allowances at 24% of the TNAC. Under the rules in place in 2022, the intake rate would drop to 12% thereafter.

$$1 - W = 1 - (1 - 0.24)^2 = 0.4224 \text{ (Perino, 2018).}$$

- For cancellations we use the "buy, bank, burn" strategy proposed by Gerlagh and Heijmans (2019). Allowances are purchased immediately but cancellation only occurs once the TNAC has dropped below 833 million, i.e. once the MSR has stopped taking in allowances. Cancellations therefore occur once the waterbed effect is again at 100% and cancellations translate 1:1 into cap reductions.

- If European Commission (EC) proposal for MSR adjustment (Fit-for-55 package) is adopted, it enters into force before the TNAC drops below 833 million and the transitional range of 833 million $<$ TNAC $<$ 1,096 million applies in at least one year. In this case all three options have the same impact on total emissions in the EU ETS. Effectiveness of "buy, bank, burn" strategy is unaffected by EC proposal. The waterbed effect vanishes until the TNAC drops below 833 million because the cumulative intake rate is 100% due to the introduction of the transitional range (Perino et al., 2022b). The latter is a simplification as it does not hold if the transitional range is not reached in at least one year.

C Tables

Table C1: Comparison of the Sample with the German Population.

	Sample	Population
Male	56.6%	49.4%
Qualification for university entrance	54.2%	31.5%
Employed	51.8%	51.2%
High net monthly household income	32.2%	27.1%
Age $<$ 25 years	0.9%	24.4%
Age 25 - 64 years	60.4%	54.2%
Age $\geq$ 65 years	38.7%	21.4%
Household size:		
1 person	26.8%	20.1%
2 persons	49.5%	33.2%
3 persons	12.1%	17.7%
4 and more persons	11.7%	29.0%

Data for the German population in 2022 is taken from Statistisches Bundesamt (2023). In that survey, the threshold for high income is €4,000, whereas we set it at €4,200.

Table C2: Summary statistics by experimental condition

	(1) *BASE*	(2) *MARKET*	(3) *SHAME*	(4) *REFORM*	(5) χ^2	(6) p-value
Female	0.4034	0.4413	0.4100	0.4290	1.5042	0.6813
Age	58.2254	57.8281	58.1801	57.4735	0.7855	0.8529
Qual. for university entrance	0.5779	0.5908	0.5069	0.5978	7.7183	0.0522
Employed	0.5398	0.5460	0.4986	0.5419	2.1564	0.5406
Net monthly household income:						
$<$ 1,200 Euro	0.0503	0.0510	0.0608	0.0152	9.2541	0.0261
1,200 - 2,700 Euro	0.2767	0.2898	0.2553	0.3506	8.1377	0.0432
2,700 - 4,200 Euro	0.3312	0.3376	0.3526	0.2683	6.2527	0.0999
$\geq$ 4,200	0.3417	0.3217	0.3313	0.3659	1.5615	0.6681
Household size:						
1 person	0.2570	0.2676	0.2541	0.2685	0.3217	0.9559
2 persons	0.4953	0.4958	0.4784	0.4932	0.3145	0.9573
3 persons	0.0994	0.1437	0.1216	0.1315	4.4072	0.2207
4+ persons	0.1482	0.0930	0.1459	0.1068	8.4362	0.0378

Column (5) contains the χ^2-statistics and column (6) the p-values for a Kruskal-Wallis equality-of-populations rank test.

Table C3: Causal Effect of Information Provision in *BASE*. Average Marginal Effects from Maximum Likelihood Logit Estimations with Covariates.

	Option *ETS*		Option *COAL*	
$d = 1$ margin	0.241	$(0.020)^{***}$	0.224	$(0.020)^{***}$
$d = 2$ effect	0.217	$(0.022)^{***}$	-0.103	$(0.018)^{***}$
Covariates	Yes		Yes	
# observations	856		856	
$\log \mathscr{L}$	-503.48		-374.50	
Wald χ^2	126.97		44.51	
Wald p	0.000		0.000	
Pseudo R^2	0.091		0.050	

Predictive margins for $d = 1$ and average marginal effects of the respective discrete change of d relative to $d = 1$. In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates include gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

Table C4: Impact of *MARKET* Condition on $d = 1$. Average Marginal Effects from Maximum Likelihood Logit Estimations.

	(1)		(2)		(3)		(4)	
Dependent variable	*ETS*		*ETS + MIX*		*ETS*		*ETS + MIX*	
BASE margin	0.231	$(0.019)^{***}$	0.771	$(0.019)^{***}$	0.239	$(0.020)^{***}$	0.777	$(0.020)^{***}$
MARKET effect	0.053	$(0.031)^{*}$	0.024	(0.029)	0.052	(0.033)	0.023	(0.031)
Covariates	No		No		Yes		Yes	
# observations	815		815		716		716	
$\log \mathscr{L}$	-459.33		-428.72		-393.31		-360.66	
Wald χ^2	2.87		0.65		32.83		21.44	
Wald p	0.091		0.419		0.003		0.091	
Pseudo R^2	0.003		0.001		0.041		0.029	

In parentheses are the standard errors clustered at the individual level. Stars indicate that a Wald test rejects the null that the respective margin is uniform or the respective effect is equal to zero at conventional significance levels (* at $p < 0.1$, ** at $p < 0.05$, and *** at $p < 0.01$). Covariates are gender, age, education, net monthly household income, household size, participation in climate protests and protests against coal, attitude towards the market economy, and attitude towards big firms.

D The Experiment in the Questionnaire

D.1 Pre-Experimental Items

Question ExpB_1: Do you have a rather negative or rather positive attitude towards large companies?

- Very negative
- Rather negative
- Neutral
- Rather positive
- Very positive

– Don't know / No answer

Question ExpB_2: Do you have a rather negative or rather positive attitude towards a market economy as an economic system?

– Very negative
– Rather negative
– Neutral
– Rather positive
– Very positive
– Don't know / No answer

Question ExpB_3: Have you participated in climate protests or demonstrations in the last five years?

– Yes, more than twice
– Yes, once or twice
– No
– Don't know / No answer

Question ExpB_4: Have you ever participated in demonstrations against coal-fired power plants or coal mining?

– Yes, more than twice
– Yes, once or twice
– No
– Don't know / No answer

D.2 General Introduction for Conditions *BASE*, *MARKET*, *REFORM*

In the context of this study, you can decide on climate protection measures that will actually be implemented.
You will now have the opportunity to prevent the emission of 10 tons of carbon dioxide (CO2). For reference: This is the amount that one person in Germany causes within a year through consumption, electricity consumption, heating, and mobility.
On the following pages we will present three measures with which you can avoid CO2 emissions. You will make your decisions afterwards.
No matter how you decide, there will be no costs for you in the context of this study. All measures are financed by public funds.
We will now explain the three different measures A, B, and C that you can choose from to prevent CO2 emissions. You can also choose not to select any of the three measures (option D). You will make your decisions afterwards.
In order to implement your decisions, we have made contracts with two companies. These companies are able and allowed to implement the measures without requiring further approvals.
As you make your decision on the following pages, you can have the following information displayed at any time via links.

D.3 General Introduction for Condition *SHAME*

In the context of this study, you can decide on climate protection measures that will actually be implemented.
You will now have the opportunity to prevent the emission of 10 tons of carbon dioxide (CO2). For reference: This is the amount that one person in Germany causes within a year through consumption, electricity consumption, heating, and mobility.
On the following pages we will present three measures with which you can avoid CO2 emissions. You will make your decisions afterwards.

No matter how you decide, there will be no costs for you in the context of this study. All measures are financed by public funds.
The emissions from electricity generation alone have increased significantly in Germany in 2021. According to the Federal Environment Agency, CO2 emissions from coal-fired power plants have increased by 17 percent compared to 2020.
We will now explain the three different measures A, B, and C that you can choose from to prevent CO2 emissions. You can also choose not to select any of the three measures (option D). You will make your decisions afterwards.
In order to implement your decisions, we have made contracts with two companies. These companies are able and allowed to implement the measures without requiring further approvals.
As you make your decision on the following pages, you can have the following information displayed at any time via links.

D.4 Introduction of Option *ETS* for Conditions *BASE*, *SHAME*, *REFORM*

A: Reduce Emission Rights in Emissions Trading
The European Union (EU) aims to rapidly and significantly reduce greenhouse gas emissions (e.g., CO2) and achieve climate neutrality by 2050. To effectively control the emissions of these gases, large power plants and industrial facilities must acquire and surrender emission rights for each ton of CO2 they emit. Once the emission right is used, it is permanently cancelled and cannot be used again. The quantity of emission rights issued by the EU is strictly limited.
By selecting Measure A, we will irreversibly withdraw emission rights for ten tons of CO2 from circulation. This means that power plants will have ten fewer emission rights available. The implementation will be carried out by ForTomorrow gGmbH.
Measure A reduces the number of emission rights available to power plants by 10 tons of CO2.
You can view this information at any time on the following pages by clicking the “Explanation” link.

D.5 Introduction of Option *ETS* for Condition *MARKET*

A: Reduce Emission Rights in Emissions Trading
The European Union (EU) aims to rapidly and significantly reduce greenhouse gas emissions (e.g., CO2) and achieve climate neutrality by 2050. To effectively control the emissions of these gases, large power plants and industrial facilities must acquire and surrender emission rights for each ton of CO2 they emit. Once the emission right is used, it is permanently cancelled and cannot be used again. The quantity of emission rights issued by the EU is strictly limited.
Emission rights represent a political intervention in the market, as the policy sets binding requirements for companies on the amount of climate protection they must undertake.
By selecting Measure A, we will irreversibly withdraw emission rights for ten tons of CO2 from circulation. This means that power plants will have ten fewer emission rights available. The implementation will be carried out by ForTomorrow gGmbH.
Measure A reduces the number of emission rights available to power plants by 10 tons of CO2.
You can view this information at any time on the following pages by clicking the “Explanation” link.

D.6 Introduction of Option *COAL* for all Conditions

B: Reduce Production of a Coal-Fired Power Plant
The German Bundestag has decided to phase out coal-fired power generation ("coal phase-out") by the year 2038. Until then, coal-fired power plants are allowed to continue operating.

By selecting Measure B, you can advance a small part of the coal phase-out. The production of a coal-fired power plant operated by STEAG GmbH will be temporarily reduced so that exactly ten tons less of CO2 will be emitted.
Measure B reduces the emissions of a coal-fired power plant in Germany by 10 tons of CO2.
You can view this information at any time on the following pages by clicking the "Explanation" link.

D.7 Introduction of Option *MIX* for all Conditions

C: Combination of A and B
Measure C is a combination of measures A and B: The number of emission rights will be reduced by five tons of CO2, and the production of the coal-fired power plant will be temporarily reduced so that exactly five tons less of CO2 will be emitted.
Measure C reduces the emission rights available to power plants by 5 tons and directly reduces the emissions of a coal-fired power plant in Germany by 5 tons of CO2. In total, Measure C covers 10 tons of CO2.
You can view this information at any time on the following pages by clicking the "Explanation" link.

D.8 Introduction of Option D for all Conditions

D: None of the Measures A-C
By selecting D, none of the climate protection measures A-C will be implemented. This means that neither the number of emission rights nor the production of the coal-fired power plant will be reduced. The reserved tax funds will be spent elsewhere.
You can view this information at any time on the following pages by clicking the "Explanation" link.

D.9 Specific Introduction for all Conditions

In the following, you will be asked to make two decisions. You can choose one of the measures described above for each decision. Each of your decisions has an equal chance of being implemented, regardless of which measure you choose each time.
Infobox: As a reminder, some decisions will be randomly selected and implemented.

> **How We Select Which Decisions Are Implemented**
> Each participant makes two decisions. All decisions are collected in a pool, from which the decisions to be implemented by STEAG GmbH and ForTomorrow gGmbH are drawn. Each decision has an equal chance of being implemented. The likelihood of implementation is approximately 1 in 60.
> All participants will receive proof via email of the climate protection measures that are implemented as part of this study by the end of the year.

On the following pages, you can always display this information by clicking on the "How we select" button.

D.10 First Decision ($d = 1$) for Conditions *BASE, MARKET, SHAME*

Info button: "Just a reminder, some decisions will be randomly selected and implemented."
You now have the opportunity to avoid 10 tons of CO2 by choosing one of the three measures A, B, or C, or explicitly choosing none of the three measures and therefore not avoiding any CO2 (measure D). You will incur no costs, no matter how you decide.
As a reminder: 10 tons are the amount of CO2 that a person in Germany generates within one year (through consumption, electricity consumption, heating, and mobility).
How do you decide?

- A: Measure "Reduce emission allowances in emissions trading": I want the number of **emission allowances** to be reduced by 10 tons of CO2.
- B: Measure "Reduce production of a coal-fired power plant": I want the emissions of a **coal-fired power plant** to be reduced by 10 tons of CO2.
- C: Measure "Combination of A and B": I want the number of **emission allowances** to be reduced by 5 tons of CO2 and the emissions of a **coal-fired power plant** to be reduced by 5 tons of CO2.
- D: None of the measures A-C: I want no CO2 to be avoided.
- Don't know / No answer

D.11 Elicitation of Beliefs about Effectiveness for all Conditions

We would like to learn more about the reasons for your decision.
Please only consider the effect of the measures on the **reduction of CO2**. Do you consider the three measures **equally effective** in reducing CO2, or do you believe that certain measures are **more effective** in reducing CO2 than others?
Please rank the three measures in terms of their effectiveness. Assign a value between 1 and 3 to each of the three measures.
The most effective measure will receive 1, the second most effective will receive 2, and the least effective will receive 3. You can also assign equal ranks.
If all three measures are equally effective, assign a rank of 1 to all of them.
If two measures are equally effective but more effective than the remaining measure, assign a rank of 1 to the two equally effective measures and a rank of 2 to the less effective measure.
If two measures are equally effective but less effective than the remaining measure, assign a rank of 1 to the most effective measure and a rank of 2 to the two equally effective measures.

A: Measure "Reduce emission allowances in emissions trading."
B: Measure "Reduce production of a coal-fired power plant."
C: Measure "Combination of A and B."
Don't know / No answer

D.12 Second Decision ($d = 2$) for Conditions *BASE*, *MARKET*, *SHAME* / First Decision ($d = 1$) for Condition *REFORM*

The three climate protection measures A, B, and C differ in how much they reduce total emissions. There are various interactions between the emissions of a coal-fired power plant, the electricity market, and emissions trading. If the production of a coal-fired power plant is reduced, the electricity is instead produced by other power plants, and the unused emission allowances are partially sold to other power plants. Both of these interactions counteract the original reduction in emissions. The reduction in total emissions is the result of the initial reduction from the measure, minus the increase in emissions from other power plants. According to calculations by scientists from the University of Hamburg, the following reductions in total emissions can be expected from measures A-C:

Climate Protection Measure	**Original Reduction**	**Expected Reduction of Total Emissions**
A: Measure "Reduce Emissions Allowances in Emission Trading"	10 tons of CO2	10 tons of CO2
B: Measure "Reduce Production of a Coal-Fired Power Plant"	10 tons of CO2	4.2 tons of CO2
C: Measure "Combination of A and B"	10 tons of CO2	7.1 tons of CO2

Against this background, you now have the opportunity to choose once again from the same three measures A, B and C or to explicitly choose none of the three measures (D). There are no costs associated with your decision, regardless of which option you choose.
Reminder: Ten tons are the amount of CO2 emitted by a person in Germany (through consumption, electricity consumption, heating, and mobility) within one year.

How do you decide?

- A: Measure "Reduce Emissions Allowances in Emission Trading": I want the number of **emissions allowances** to be reduced by 10 tons of CO2.
- B: Measure "Reduce Production of a Coal-Fired Power Plant": I want the emissions of a **coal-fired power plant** to be reduced by 10 tons of CO2.
- C: Measure "Combination of A and B": I want the number of **emissions allowances** to be reduced by 5 tons of CO2, **and** the emissions of a **coal-fired power plant** to be reduced by 5 tons of CO2.
- D: None of the Measures A-C: I want no CO2 to be avoided.
- Don't know / No answer

D.13 Second Decision ($d = 2$) for Condition *REFORM*

The legal framework for the provision of emissions allowances for power plants and industry is currently being revised:
The European Commission has made a **proposal**. If accepted, all three measures A, B, and C will lead to the same reduction in total emissions. **In this case**, all three climate protection measures would actually reduce total emissions by **10 tons of CO2**. The reductions in total emissions would be as follows:

Climate Protection Measure	**Original Reduction**	**Expected Reduction of Total Emissions**
A: Measure "Reduce Emissions Allowances in Emission Trading"	10 tons of CO2	10 tons of CO2
B: Measure "Reduce Production of a Coal-Fired Power Plant"	10 tons of CO2	10 tons of CO2
C: Measure "Combination of A and B"	10 tons of CO2	10 tons of CO2

However, it is **currently uncertain** whether the Commission's proposal will be implemented. Approval from the European Parliament and the Council of the European Union is still required.
Against this background, you now have the opportunity to choose once again from the same three measures A, B and C or to explicitly choose none of the three measures (D). There are no costs associated with your decision, regardless of which option you choose.
As a reminder, 10 tons is the amount of CO2 that an individual in Germany generates within one year through consumption, electricity usage, heating, and mobility.
How do you decide?

- A: Measure "Reduce Emissions Allowances in Emission Trading": I want the number of **emissions allowances** to be reduced by 10 tons of CO2.
- B: Measure "Reduce Production of a Coal-Fired Power Plant": I want the emissions of a **coal-fired power plant** to be reduced by 10 tons of CO2.
- C: Measure "Combination of A and B": I want the number of **emissions allowances** to be reduced by 5 tons of CO2, **and** the emissions of a **coal-fired power plant** to be reduced by 5 tons of CO2.
- D: None of the Measures A-C: I want no CO2 to be avoided.
- Don't know / No answer

D.14 Elicitation of Preferences about Financial Impact for all Conditions

We would like to learn more about the reasons behind your decisions once again. Besides the climate impact, measures A to C can also differ in terms of who is **financially burdened or relieved**. Please think about the perceived financial effects for this question, **not** the climate impact:
Which measure appeals to you the most in terms of its financial impact?
Please rank the three measures in terms of their financial impact, assigning a value of 1 to 3 for each of them. The measure you find most appealing in terms of financial impact will receive the value 1, the second most appealing will receive 2, and the third will receive 3.
You can also assign equal ranks.
If you find all measures equally appealing, assign a rank of 1 to all.
If you find two measures equally appealing, but more than the remaining measure, assign the value 1 to the two best measures and 2 to the less appealing measure.
If you find two measures equally appealing, but less appealing than the remaining measure, assign the value 1 to the best measure and 2 to the other two measures.

A: Measure "Reducing Emissions Allowances in Emissions Trading".
B: Measure "Reducing Production of a Coal-fired Power Plant".
C: Measure "Combination of A and B".
Don't know / No answer